James Acker :
Our next presenter in the mini-infectious disease theme is Dr. Michael Wimberly.

Yes! Michael is from South Dakota State University. Go, Mike -

1.   This presentation will highlight the results of three recent studies, all
of which are focused on the application of satellite remote sensing data for forecasting
and mapping of malaria outbreaks in the Ethiopian highlands.

Our study area is the Amhara region of Ethiopoia, a densely populated region. Most people
live in rural areas and practice subsistence farming.

This is an area of unstable malaria transmission, and is prone to sporadic epidemics that
cause high morbidity and mortality in all age classes of the population.

Disease forecasting has the potential to help direct and improve malaria prevention and
control activities. However, predictions need to be accurate to be effective.

We collected historical malaria surveillance data with the collaboration of the Health,
Development, and Anti-Malaria Association, an Ethiopian NGO. We carried out exploratory
analysis of these data to identify major spatial, temporal, and spatio-temporal patterns.

Temporal patterns of malaria cases during the main epidemic season (Sept-Dec) highlight
the major epidemic years (2003-2005) compared to years with fewer malaria cases (2001,
2007, 2008). However, there was also considerable variability in temporal patterns
among the districts.

Malaria cases exhibited statistically significant spatial autocorrelation in most years.
Areas with a high concentration of malaria cases (for examples, the districts around
Lake Tana) are visible in the maps.

There was positive spatial synchrony of malaria cases at spatial scales up to 300 km,
indicating that malaria outbreaks tended to occur over relatively large areas.

We conducted a time series analysis of the influences of remotely-sensed climatic variables on temporal patterns of malaria cases.
We addressed three major research questions.

Data on outpatient malaria cases and remotely sensed environmental variables were summarized at the woreda (district) level for 12 districts.

Independent variables included land surface temperature…

NDVI and EVI provided indicators of near-surface moisture…

Precipitation data was obtained from the TRMM 3B42 products…

We also explored the use of modeled actual evapotranspiration as an indicator of surface moisture availability.

We fitted SARIMA models that adjusted for trends and seasonality and accounted for temporal autocorrelation.

SARIMA models incorporating remotely-sensed variables fit the data well and were able to make accurate 1-month ahead predictions.

These were the major results. They highlight the potential utility of remote sensing data for malaria early warning, but also emphasize the need to combine environmental monitoring data with timely malaria surveillance data to get the most accurate predictions.

We also developed a simpler approach based on remotely-sensed environmentla anomalies for making season predictions of epidemic malaria risk.

These are preliminary results from a recent conference proceedings paper.

We focused on predicting interannual variability in malaria risk during the main epidemic season (Sept-Dec).

The main epidemic season occurs right after the main rainy season.

The warmest part of the year is prior to the main rainy season.

Our hypothesis was that environmental variables from Jan-August would provide indicators of risk for the subsequent epidemic season.

It doesn't like my formulas! Releative risk was computed as the log ratio of expected to observed cases for a given district in a given year.

You can think of it as a malaria case "anomaly" for a given location.

It doesn't like these formulas either.

The main idea here is that were focusing on temporal variability - malaria case anomalies as a function of climatic anomalies.

These are correlations between environmental variables measured at different times of the year with Sept-Dec malaria risk.

Red dashed lines indicated singificance at alpha=0.05

This is a summary of results from the previous slide.

We identified particular parts of the season where there is strong sensitivity of

malaria epidemics to climatic variability.

We also combined these indices to devleop statistical models of malaria risk.

The fit of two of these models is illustrated here.

Model (A) includes both environmental and epidemiological vairables.

Model (b) is based only on environmental variables.

Here are relative risk predictions from the models combined into three categories.

The fitted data captures the 2003 epidemic and the increase in malaria cases in 2009.

2010-2012 are predictions based on remotely-sensed environmental data.

We are currently expanding on this research in several areas.

Our long-term goal is to develop novel "eco-informatics" tools that integrated environmental monitoring and disease surveillance.

Improving integrating with online resources like Giovanni is a part of this effort.

This slide is a little messed up, but you can see the logos of our collaborators and funders. Thanks to all!

That's it!

James Acker :

Thank you very much, Michael. I think WebEx was designed for people that don't like math.

Mike Wimberly :

Ha! Perhaps so.